identical optical properties. Brilliant green alone in thin layers is blue rather than green, and though it shows dichromatism, the change from blue to red is not nearly so striking as a change from green to red. The prisms can be made in the following way.

A quantity of Canada balsam is boiled in an evaporating dish until a drop placed on a cold surface becomes quite hard. The dye must not be added until the balsam has cooled almost to the point of becoming thick, otherwise it will be decomposed and a very muddy green result.

Enough brilliant green must be dissolved in the balsam to make it appear deep red in layers 1·5 cm. thick. Thin layers will be found to be blue. The naphthol yellow is now added in quantity sufficient to change the tint of thin layers from blue to green. Possibly some samples of the dye will not require the addition of the yellow, but all which I have tried are improved by the process. A hollow prism is now made by fastening two pieces of thin plate glass between two grooved strips of wood. The base of the prism should be about 2 cm. thick if the strips of glass are 4 cm. long. The plates are warmed with a flame and the coloured balsam poured between them. After the balsam has cooled it is a good plan to run a quantity of melted sealing-wax upon the top of it, which strengthens the prism. An incandescent lamp or gas flame viewed through the prism is seen divided into a green and a red image, the former gradually fading away as the eye is moved towards the base of the prism.

If a larger amount of the colouring matter be added to the balsam and the fluid be pressed out between pieces of plate glass, screens can be made which transmit a very good secondary yellow. Through these screens a sodium flame is absolutely invisible, though a gas flame appears of a colour very closely resembling the soda flame in tint. The colour of the transmitted light depends also on the original composition of the light. By a suitable adjustment of the dyes a screen can be made which appears red by lamplight and green by daylight, illustrating very well the peculiarity of the Alexandrite crystals.

Johns Hopkins University, Baltimore. R. W. WOOD.

Sun-pillar and Parhelion.

As the area over which such effects are visible is of some interest, it may be well to mention that a sun-pillar was visible in Dublin at 7 p.m. on Monday, April 28. It was preceded at 6 p.m. by an unusually fine parhelion display, a portion of which was hidden from my view by houses. Two concentric circles and an inverted arc touching the inner one were visible, with a mock sun at the left hand end of the horizontal diameter of the inner circle, and probably another, hidden from me, on the right. The wind all the previous day had been cold from the north-east, in a fairly clear air, and still blew from about north. The sky was full of streamers and wisps of cirrus cloud. Doubtless a far more complete account can be given by other observers. GRENVILLE A. J. COLE.

Royal College of Science, Dublin, April 30.

A Rare Wild Sheep.

SPORTSMEN and naturalists will be interested to learn that Mr. Talbot Clifton, who has recently been travelling in northern Siberia, has brought home from the valley of the Lena the skin and skull of a wild sheep of which no complete examples have hitherto been known in England. This sheep is the *Ovis borealis* of Severtzoff, a near ally of the bighorns of Kamchatka and Alaska. As it has no English name, it may well be known as Clifton's bighorn. The skin is being mounted by Rowland Ward, Ltd., and will before long be exhibited to the Zoological Society. R. LYDEKKER.

Beechen Hedges on Elevated Ground.

IN your issue of April 10, Mr. Wm. Gee, of Buxton, expresses his surprise that some beechen hedges and smaller trees in his neighbourhood have maintained their foliage through this winter, "contrary to the habit of deciduous trees."

I beg to state that in Denmark, where beeches abound, these trees always behave in the same manner as those in Buxton did this year. An underwood of young beeches, densely covered with dry, brown, rattling foliage, is quite a characteristic feature of Danish woodland scenery.

It would be most interesting to learn whether the beeches in England really used to throw off their leaves in autumn, and to ascertain the causes of such a different behaviour of the same species of tree in two countries of approximately the same climate. How this holding of the leaves could be a protective device to the individual young beech I cannot imagine; but to the whole underwood, or wood, this phenomenon might be protective, keeping out the cold winds of winter.

18 V. Boulevard, Copenhagen. JUL. WULFF.

IN reply to the interesting communication from Copenhagen anent the Buxton beeches, I would remind your correspondent that, as stated, the matured trees in the plantations hereabouts drop their leaves in the autumn as usual, the retention of them being observable only upon small young trees, and in the beechen hedges, and that this effect is not noticed, in this neighbourhood, for the first time.

It may give colour to the suggestion that this holding of the past season's leaves is an extra device under pressing circumstances to remember that the tissue of such accessory organs as scales, bracts and stipules is of feebly conducting material, and that these dry beech leaves, acting as such, would also enclose a film of air which would tend to give fuller protection from the frosts which this winter have been uncommonly severe, the local observatory (in connection with Westminster) registering down to 3° Fahr.

We have the highest authority for considering the beech as an unusually resourceful tree, as shown in its vernation, the growth of its bark and the care of its seeds; and it would not be surprising to hear of its making a special defence against a special attack, and being successful as a "survival of the fittest."

Barlbro' Cottage, Buxton, April 28. WM. GEE.

CHEMICAL INSTRUCTION AND CHEMICAL INDUSTRIES IN GERMANY.

NO more striking illustration of the position which Germany has won for herself in chemical technology, and of the industrial preeminence which she has thereby secured in one of the most highly developed branches of the chemical arts, could have been given than that afforded by Prof. Witt in the lecture theatre of the Royal Institution on Friday evening, March 21; and to the observant eye no object-lesson could be more significant or more forcible than that presented by the remarkable series of chemical products, the outcome of the work of German manufacturers, which Prof. Witt had gathered together to point the moral of his discourse.

In a few years we shall behold the extinction of one more agricultural industry, and the indigo plantations of India will have gone the way of the madder fields of Avignon. The death-knell of natural indigo has been sounded; the planter may struggle on for a while in a futile effort to withstand the inevitable; prejudice and trade customs may delay the fall of the fateful sword; but the machinations of the German chemist, backed by the German capitalist, have slowly but surely compassed his ruin, and it is but a question of time when it will be accomplished.

The conditions which have conduced to this result have been indicated, time and again, in these columns. But no more eloquent commentary on these causes could be adduced than is afforded by the report on chemical instruction and chemical industries in Germany recently made to the Foreign Office by Dr. Frederick Rose, His Majesty's Consul at Stuttgart, and which has recently been published.[1]

This report deals with the facilities, and expenditure, for chemical instruction at the two Prussian Technical High Schools at Berlin and Hanover, and at the University of Berlin, and is supplementary to a report on chemical instruction and chemical industries in Germany already made public by the Foreign Office.

The following brief analysis of this report will serve to show by what methods the State has deliberately paved the way for the result foreshadowed in at least one branch of chemistry in Prof. Witt's discourse.

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[1] Diplomatic and Consular Reports, No. 573, Miscellaneous Series.

Let us take the Berlin Technical High School first. In this school there are six fully qualified professors for the following branches of chemistry :—(1) Organic chemistry ; (2) inorganic chemistry ; (3) chemical technology ; (4) metallurgy ; (5) electrochemistry ; (6) photochemistry.

In addition there are six lecturers for the following branches :—(1) Chemistry of foods, including analytical and bacteriological methods ; (2) agricultural-chemical technology (sugar, beer, spirits, &c.) ; (3) vegetable and animal fats, oils, &c., investigation of mineral oils and naphtha products ; (4) designing of chemical works and plant ; (5) architectural chemical technology ; (6) physical chemistry, thermochemistry, &c.

Finally, twelve *privat docenten*, or private lecturers, for the following branches :—(1) Electrolytic metallurgy ; (2) chemistry of foods ; (3) ceramics ; (4) chemistry of the growth of plants ; (5) investigation of oils, fats and naphtha ; (6) technology of proteids and albuminoids ; (7) repetition of organic chemistry ; (8) chemistry of cements, mortar, plaster, &c.; (9) qualitative and quantitative analysis ; (10) coal tar dyes ; (11) terpenes and camphors ; (12) modern synthetic drugs.

The following table gives the number of professors and students for a series of years from 1885-99 :—

	1885.	1890.	1895.	1899.
Professors	4	5	5	6
Lecturers	3	2	6	8
Private lecturers	5	3	11	12
Assistants	7	13	13	15
Students	89	172	171	278

It will be seen that in 1899 there were no fewer than 41 professors, lecturers, private lecturers and assistants to 278 students, or about one instructor to seven instructed.

The laboratories for organic chemistry, photochemistry, metallurgy and chemical technology are contained in a building erected in 1884. The increase in the number of students has now rendered the erection of new buildings necessary ; these will be begun this year, and will probably cost 27,500*l.* exclusive of the site, which is valued at 10,000*l.* For the same reason, a new building will shortly be erected for the electrochemical laboratory, which is at present located in the palatial building of the Technical High School.

The department for instruction in chemistry at the Hanover Technical High School differs from that of the Berlin Technical High School, inasmuch as the chemical-technical and electro-technical branches are combined in one department.

The principal chairs of chemistry are four in number :—(1) Inorganic chemistry ; (2) organic chemistry ; (3) chemical technology ; (4) electrochemistry.

The following table gives the total number of professors, &c., and assistants and students for a series of years :—

	1885.	1890.	1895.	1899.
Professors	4	5	5	6
Lecturers	2	1	1	2
Private lecturers	—	1	4	4
Assistants	4	5	9	11
Students	64	81	192	285

In 1899 the proportion of instructors to instructed was 23 to 285, or about 1 to 12.

The department of chemistry at the Berlin University forms one of the subdivisions of the faculty of philosophy, and the professors of chemistry are members of the philosophical faculty.

The professorial staff includes :—(1) One professor of organic chemistry ; (2) one professor of inorganic chemistry; (3) one professor of pharmaceutical chemistry; (4) one extraordinary professor of chemical technology; (5) one extraordinary professor from the Berlin Technical High School ; (6) one extraordinary professor from the Veterinary High School ; (7) one extraordinary professor from the Imperial Patent Office ; (8) one extraordinary professor from the Royal Department for Testing Explosives; (9) three extraordinary professors who also form the managing board of the two principal chemical institutes (see under) ; (10) twelve private lecturers ; (11) twenty assistants in the different laboratories for inorganic, organic, pharmaceutical and technological chemistry.

The chemical department of the Berlin University possesses the following subdivisions for chemical instruction :—(1) The First Institute of Chemistry, conducted by the professor with a managing board of two extraordinary professors and eleven assistants ; (2) The Second Institute of Chemistry, with one managing extraordinary professor and three assistants ; (3) The Chemical-Technological Institute, with one extraordinary professor and two assistants ; (4) The Chemical-Pharmaceutical Institute, with one extraordinary professor and four assistants.

The report does not give the number of students of chemistry who have studied at Berlin during the past, as they are not inscribed specially as students of chemistry, but are entered as belonging to a subdivision of the philosophical faculty. It is not possible, therefore, to determine exactly what proportion of the total natural-science students were actually students of chemistry, although there is reason to assume that the proportion is large :—

	Students in the Philosophical Faculty.	Students in the subdivision of natural science.
1885	1955	813
1890	1761	515
1895	1551	512
1899	2162	784

It is stated that the decrease in the number of students for the years 1890 and 1895 was partially caused by the lack of sufficient and suitable accommodation in the chemical laboratories and lecture-rooms, a defect now remedied by the erection of the splendidly equipped building in the Sophien-Strasse.

The following table gives the annual expenditure for new apparatus, instruments, chemicals, repairs, &c., of the above-mentioned four chemical institutes at the Berlin University. The sums given do not include the salaries of teachers, assistants, or laboratory servants :—

	First Chemical Institute.	Second Chemical Institute.	Technological Institute.	Pharmaceutical Institute.	Total.
	£	£	£	£	£
1885	645	724	476	275	2120
1890	719	564	398	275	1956
1895	794	564	398	275	2031
1899	1052	614	398	275	2339
1901	2792	614	398	275	4079

From the above table it is seen that the annual expenditure for the First Chemical Institute for instruments, apparatus, chemicals, &c., alone, *i.e.* apart from the salaries of the professors, lecturers, &c., has increased more than fourfold since 1885.

The First Chemical Institute was erected between 1860 and 1870 at the following cost :—

Building site	£13,500
,, expenses	27,505
Internal equipment	3,985
	44,990

During the last fifteen years, however, the great increase in the number of students of organic chemistry drawn to Berlin by the fame of Hofmann and Emil Fischer has rendered necessary the erection of a new building for the First Chemical Institute. This was built between 1897 and 1901 at a total expenditure of 70,000*l.*, to which 7500*l.* was added for the purchase of instruments, apparatus, &c. The value of the building site was probably 30,000*l.* to 40,000*l.*

The Second Chemical Institute and the Technological Institute were both built after 1870, and have repeatedly received large sums for apparatus and instruments.

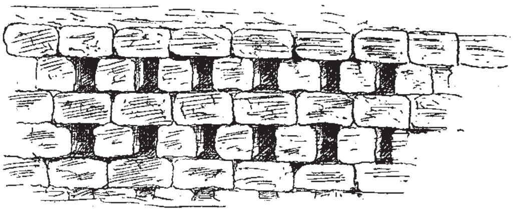
A new building is at present in course of erection for the Institute of Pharmaceutical Chemistry, estimated to cost 26,250*l.* without the value of the site, which may amount to 10,000*l.* The annual vote for instruments, &c., is to be raised from 225*l.* to 750*l.*

These figures, as Consul Rose states, are eloquent enough, and show clearly what facilities are provided in these great institutions for tuition in all branches of chemistry. "Finally they show—and this is, perhaps, the most significant indication of all—that the Prussian State, in spite of the expenditure already incurred, and the leading position attained by the chemical industries, is far from regarding the present admirable means of chemical instruction as adequate for future contingencies, but is at all times, after representations from the requisite industrial and educational quarters, prepared for further lavish outlay should future developments reveal this necessity." T. E. THORPE.

RHODESIA AND OPHIR.[1]

IN this handsome and copiously illustrated volume are embodied the results of six years' (1895–1900) systematic exploration amongst the numerous prehistoric remains of all kinds which are widely scattered over the whole region between the Zambesi and the Limpopo, and even range at some points into the conterminous districts of North Transvaal and Bechuanaland. During the operations, which were conducted under grants from the Chartered Company licensing these researches, the authors, with their indefatigable colleague, Mr. George Johnson, personally inspected nearly two hundred ruins, a list of which is here given and a great many of which are described in more or less detail. They further tell us that, so far from being completed, the work of exploration has scarcely been more than well begun, that their precursors and contemporaries—Bent, Mauch, Baines, Maund, Willoughby, Swan, Schlichter, White—have merely scratched the surface, and that of more than five hundred temples, citadels, enclosures, chains of forts, gold workings and terraced slopes reported from various districts and covering a total area of at least 115,000 square miles, not a tenth part has yet been thoroughly examined. This will be read with surprise by those archæologists who supposed that after Bent and Swan's classical descriptions of the "Great Zimbabwe" and a few neighbouring monuments, little more remained to be discovered. But the statement is supported by abundant first-hand evidence, and it is shown that Zimbabwe itself "is still practically unexplored," while elsewhere the original floors of the *earlier* structures still rest for the most part buried under ten or even fifteen feet of the accumulated débris of ages.

That there are earlier and later structures, bespeaking either a long continuous or an intermittent occupation of the land by foreign intruders, is placed beyond all doubt, and a comparative study of the various groups so far explored has enabled the authors tentatively to classify them in four categories, clearly indicating time sequences ranging from at least 1000 B.C., possibly even 2000 B.C., down to the advent of the Mohammedan Arabs and Portuguese. The buildings of the first period, of which the Great Zimbabwe is typical, are marked by great solidity and superior workmanship, with massive walls of dry masonry resting on the bed-rock, often 15 to 17 feet thick at base, batter-backed both inside and outside, with no false courses, but bonded throughout their entire width and diversely ornamented with dentelle, check, chevron and especially herring-bone patterns (Fig. 1). These are assigned with Bent, Schlichter and myself to the South Arabian Himyarites, and are compared—in their characteristic elliptical curves, the absence of mortar and other details—with the ruined temples and palaces of Marib (Maraiaba Bahramalakum), capital of the ancient Sabæan empire.



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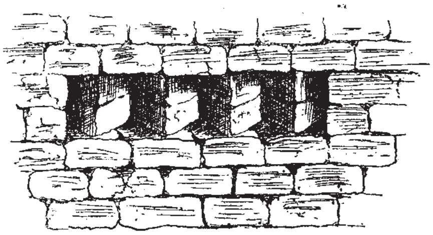

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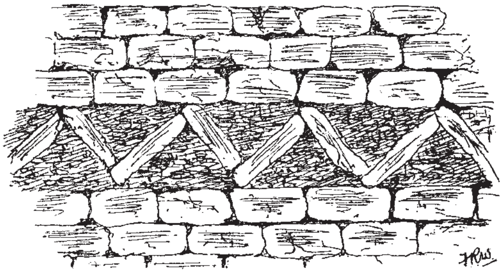

CHEVRON PATTERN

DECORATIVE PATTERNS

FIG. 1.

To the Phœnician successors of the Sabæans are assigned the less substantial and otherwise somewhat inferior structures of the second period, which are either superimposed upon, or else form extensions of, the earlier monuments, and also occur by themselves generally in districts farther removed from the east coast. This is, of course, what we should expect to find on the assumption that the Himyarites were the first arrivals, and settled in the rich auriferous tracts (Manica, Sabi basin, Mashonaland) lying nearest to the seaboard. Yet remains of the first period are also met sporadically farther west in various parts of Matabililand, which may be explained either by assuming a very long pre-Phœnician Sabæan occupation or a joint Sabæo-Phœnician occupation probably in Solomonic times, when we know that peaceful relations prevailed between the Israelites, Hiram, King of Tyre, and Balkis, Queen of Sheba. It was then that the auriferous stream, which had already reached Palestine during the reign of David, rose to high-water level, and it is here suggested that

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[1] "The Ancient Ruins of Rhodesia." By R. N. Hall and W. G. Neal with above seventy illustrations, maps and plans. Pp. xxvii + 396. (London Methuen and Co., 1902.) Price 21*s.* net.